

Serial No.: 09/943,859
Group Art Unit: 2652

AMENDMENTS TO CLAIMS

- Please amend pending claims 1, 6, 11, and 16 as indicated below. A complete listing of all claims and their status in the application are as follows:

1. (currently amended) A method for manufacturing a hard bias spin-dependent tunneling sensor comprising:

forming a first lead;

forming a first gap spacer adjacent the first lead;

forming a hard magnet over the first lead, and around and in contact with the first gap spacer;

forming a free layer over the hard magnet;

forming a tunneling barrier layer over the free layer;

forming a first pinned layer over the tunneling barrier layer and overhanging the hard magnet;

forming a nonmagnetic coupling layer over the first pinned layer;

forming a second pinned layer over the nonmagnetic coupling layer;

forming a pinning layer over the second pinned layer; and

forming a second lead over the pinning layer.

2. (currently amended) The method as claimed in claim 1 including:

forming ~~a~~the first gap spacer over the first lead; and

forming a second gap spacer over the pinning layer whereby the free layer is equidistant from the first and second leads.

3. (currently amended) The method as claimed in claim 1 including:

forming ~~a~~the first gap spacer using a bilayer process; and

~~forming the hard magnet includes forming the hard magnet around the first gap spacer.~~

4. (original) The method as claimed in claim 1 wherein:

forming the first lead includes using a bilayer process in forming a recess therein;

forming the hard magnet includes forming a seed layer in the recess of the first lead;

and

forming the hard magnet includes forming a hard biasing material over the seed layer.

Serial No.: 09/943,859
Group Art Unit: 2652

5. (original) The method as claimed in claim 1 wherein:
forming the free layer, the tunneling barrier layer, the first pinned layer, the nonmagnetic coupling layer, and the pinning layer includes using a bilayer process;

and including:

forming an insulator over the hard magnet and around the free layer, the tunneling barrier layer, the first pinned layer, the nonmagnetic coupling layer, the second pinned layer and the pinning layer.

6. (currently amended) A method for manufacturing a hard bias spin-dependent tunneling sensor comprising:

providing a substrate;

forming over the substrate, a shield/first lead of a conductive material;

forming a first gap spacer adjacent the shield/first lead;

forming over the shield/first lead, a hard magnet containing a material selected from a group consisting of cobalt, chrome, platinum, tantalum, and a combination thereof, the first hard magnet is formed around and in contact with a first gap spacer;

forming over the hard magnet, a free layer containing a material selected from a group consisting of cobalt, iron, nickel, and a combination thereof;

forming over the free layer, a tunneling barrier layer containing a material selected from a group consisting of aluminum, chromium, an oxide, a nitride, and a combination thereof;

forming over the tunneling barrier layer and overhanging the hard magnet, a first pinned layer containing a material selected from a group consisting of cobalt, iron, nickel, and a combination thereof;

forming over the first pinned layer, a nonmagnetic coupling layer containing ruthenium;

forming over the nonmagnetic coupling layer, a second pinned layer containing a material selected from a group consisting of cobalt, iron, nickel, and a combination thereof;

Serial No.: 09/943,859
Group Art Unit: 2652

forming over the second pinned layer, a pinning layer containing a material selected from a group consisting of platinum, palladium, manganese, iron, nickel, iridium, an oxide, and a combination thereof; and
forming over the pinning layer, a shield/second lead of a conductive material.

7. (original) The method as claimed in claim 6 including:

forming over the shield/first lead, ~~a~~ the first gap spacer from a nonmagnetic and conductive material; and

forming over the pinning layer, a second gap spacer from a nonmagnetic and conductive material whereby the free layer is equally spaced from the shield/first lead and the shield/second lead.

8. (previously presented) The method as claimed in claim 6 wherein:

forming the first gap spacer uses a bilayer process; and

~~forming the hard magnet includes forming the hard magnet around the first gap spacer.~~

9. (original) The method as claimed in claim 6 wherein:

forming the shield/first lead includes using a bilayer process in forming a recess therein;

forming the hard magnet includes forming a seed layer in the recess of the shield/first lead;

forming the hard magnet includes forming a hard biasing material over the seed layer; and

forming the free layer forms the free layer in contact with the hard magnet.

10. (original) The method as claimed in claim 6 wherein:

forming the free layer, the tunneling barrier layer, the first pinned layer, the nonmagnetic coupling layer, and the pinning layer includes using a bilayer process;

and including:

forming an insulator over the hard magnet and around the free layer, the tunneling barrier layer, the first pinned layer, the nonmagnetic coupling layer, the second pinned layer and the pinning layer.

Serial No.: 09/943,859

Group Art Unit: 2652

20. (original) The sensor as claimed in claim 16 including:
an insulator over the hard magnet and around the free layer, the tunneling barrier
layer, the first pinned layer, the nonmagnetic coupling layer, the second pinned
layer and the pinning layer.